Bison, Postmaster.—Funnel-shaped cloud at 5 p. m., central time, moved northeast with a right to left motion, accompanied by heavy rain and lightning; path observed about eight miles long, width, 50 feet; two outbuildings destroyed; two distinct tornadoes formed, one to southwest, the other to northeast of Bison, both traveling northeast.

Garber, B. A. Garber, Postmaster.—Funnel-shaped cloud at 6 p. m., central time, moved northeast with left to right motion, trees falling to west on north side, and east on south side, in center of path following direction of storm; accompanied by heavy rains, hail, and lightning, and a loud roar; cloud black; length of path two miles, width, two hundred yards; Mrs. B. Shawver and three children injured, and the Shawver house and outbuildings destroyed, total loss, $1500.

SOME TEMPERATURES TAKEN ON LAKES HURON AND SUPERIOR IN JULY AND AUGUST OF 1904.

By F. L. ODENBACH, S. J., Director, Cleveland Observatory. Dated April 15, 1905.

From July 19 to 25, 1904, I passed over the Lakes from Cleveland to Duluth. To while away the time I occasionally took some temperatures both of the atmosphere and the water. Finding that these observations proved very interesting to the hydrographer at Duluth, more were taken on the return trip from August 2 to 7. Though not numerous, some of them are interesting and may, as has often been the case, serve to confirm some well conceived theory, or to discourage one which has been too daringly advanced.

The weather during the trip from Cleveland to Duluth was fair, with the one exception of a thunderstorm on Lake St. Clair and Saginaw Bay, which will account for the low temperature of the air at that point. The wind during both passages was light, except on August 2, at night, when we experienced a pretty stiff breeze from the east. On July 24, from 10 to 11 a. m., we observed a mirage above the hills south of Marquette. The temperatures here given were taken on the shady side of the ship. Water was drawn up the side in a tin can, the thermometer read three or four times within five minutes, the instrument then dried and the temperature of the atmosphere taken with the same thermometer.

The temperature of the water in the tin can was observed to remain steady for about ten minutes, or so long as the tin remained wet on the outside; when dry it began to rise slowly.

The very low temperature of 39.2° off Stannard Rock is very remarkable. I was so surprised that I dipped water two or three times and called on the captain to take a reading in order to be certain that I was not deceived. The night was bitter cold and the sky as clear as I have ever seen it.

FROM CLEVELAND TO DULUTH.

Date.	Water.	Atmosphere.	Location.
	°	°	
July 22, 10 a. m.	63.5	61.5	Off Saginaw Bay.
7 p. m.	62.6	61.7	Off Middle Island.
July 23, 7 a. m.	60.8	57.2	Mud Lake.
8 p. m.	55.4	50.0	Off Vermillion Point.
July 24, 7 a. m.	39.2	44.6	Off Stannard Light.
July 25, 7 a. m.	51.8	57.2	Outer Island.
noon	62.4	64.4	
3 p. m.	63.8	68.0	
5 p. m.	55.2	67.6	Bark Bay.

FROM DULUTH TO CLEVELAND.

	°	°	
August 2, 11 a. m.	64.6	70.1	Two miles east of Duluth.
2 p. m.	62.2	64.4	
3 p. m.	63.6	68.0	
5 p. m.	55.0	67.6	
8 p. m.	54.5	62.0	Sand Island.
9 p. m.	50.0	56.6	
11 p. m.	51.8		
August 3, 7 a. m.	48.2	50.0	Off Fourteen-mile Point.
10 a. m.	51.8	59.0	Five miles west of Portage Canal.
10.30 a. m.	58.8	65.3	Mouth of canal.
noon	68.5	76.1	Pilgrim Point buoy.
2 p. m.	55.4	70.7	East end of canal.
5 p. m.	57.2	62.2	Huron Island.
8 p. m.	57.2	62.6	Off Stannard Rock.
midnight	48.2		Grand Island.
August 4, 6 a. m.	44.6	55.8	Fifteen miles off Grand Marais.
1 p. m.	56.3	67.2	Whitefish Point.

The course sailed was by way of Detour Channel. From St. Marys River NW. ½ N. to Whitefish Point; then W. ½ N. for Huron Island, thence W. ⅝ S. for Portage River; from west end of river W. ½ S. to Devils Island; then SW. ¼ W. to Duluth. With the fair weather we were making seventeen knots per hour.

The return was made over the same course.

A COLD WEATHER DUST WHIRL.

By F. W. PROCTOR, Fairhaven, Mass., dated March 13, 1905.

On the morning of March 13, 1905, just before 11 o'clock, the writer observed an interesting dust whirl that had generated over frozen ground. It seems to be worth reporting, in view of the tendency among meteorologists to exclude convection as a factor in the large whirls of the winter half of the year.

The sky was clear, the wind nearly calm as shown by the rising smoke columns from chimneys, though there was a gentle movement of the air from the southwest, the barometer high, and the shade temperature fifteen minutes later was 31.5° F., as shown by a sling thermometer.

The whirl formed over or near a macadamized highway. It was first noticed by reason of the rustling of the branches of some roadside trees, and since it did not die out or move away within about a minute, it was thereafter timed by the watch. By moving along the highway a little, it was possible to approach the center of the whirl, and the horizontal wind there was estimated at twelve miles an hour. Owing to the scarcity of loose litter on the fields and gardens nearby, it was not possible to observe the vertical velocity of the air currents, and the entire diameter of the whirl. But at the expiration of five minutes, the inflowing wind could plainly be perceived when the center was shown by small pieces of whirling débris to be about 100 feet away.

Fortunately just then a triangular piece of newspaper about 12 by 18 inches was picked up by the whirl, and could be watched continuously during the next five minutes. The paper rose slowly, without regular gyration, to a height estimated at 500 feet or more, drifted slowly toward the northeast, and finally disappeared without falling, so far as could be observed.

Thus, the whirl endured at least eleven minutes, and probably considerably longer.

The preceding night was cold enough to freeze the ground, and the morning insolation must have been mainly used up in softening the surface. Under these conditions, with the air temperature at 31.5° F., there could not have been much heating of the lower air layers except over the highway, which was drier than the adjacent lands, and would become heated more easily.

Apparently the whirl formed over the highway, but it soon moved off; and it would seem that its further activity must have been due in large part, to cooling aloft.

NOTE ON THE WINDS OF THE REGION ADJACENT TO THE GULF OF CALIFORNIA.

By Prof. GEORGE H. STONE, Mining Engineer.

I spent the winter of 1900-1901 in the Chiricahua Mountains in southeastern Arizona. In December a series of storms began, which lasted till the next May. At first the storms came at intervals of three or four weeks, but gradually they came oftener till March and April, when it snowed and sleeted almost continuously for nearly a month. All these storms were preceded and accompanied by southerly winds.

The winter of 1904-5 I have spent near Arizpe, Sonora, Mexico. There had been almost no rain in this region for three years until last July, when the summer rains were very violent. In November there were one or two very light rains. Early in December we had a more severe rain, which lasted three days. Then the weather was pleasant until early in January, when it rained very violently for several days. Then the

storms became more frequent, at first once a week, then every three to five days, until in late February and early March it rained almost every day, often several times a day in the form of showers. The weather of 1900-1901 is being repeated after the long intermediate drought. In all these storms the rain-bearing winds have come from the south, or a little east or west of south, hence from the ocean. Several thousand miles of wind have passed northward.

It does not appear probable that such long-continued winds are wholly connected with passing areas of low barometer. They more nearly resemble persistent monsoons, perhaps the anti-trades. It is generally supposed that the summer movement of Pacific air northward and eastward over Mexico and the adjacent portion of the United States is due to a partial vacuum over the heated land. The winter movement must be due to a *plenum* over the sea, if we use the correlative term.

Several questions arise—

1. What relation do these movements of moist sea air eastward and northward over the lands adjacent to the Gulf of California bear to the anti-trades, the Pacific region of calms, and the area of high barometer of the northern Pacific Ocean?

2. How far north and east do these winds carry their moisture?

3. What connection did the extremely wet, alternating with dry, seasons have with the recent great variations of solar radiation observed by Professor Langley by aid of the bolometer?

4. Did the volcanic eruptions have any effect on these seasons?

Postscript.—Dated March 22, 1905, at Arizpe, on the Sonora River, in Sonora County, Mexico, latitude N. 30° 20′, longitude W. 110°, Greenwich.

It rained every day till it ended in a tremendous downpour on March 8-9. Then it was pleasant for three days; then we had one and one-half days of heavy showers, clearing up by the 15th. The high cirrus streamers on the 15th showed that the upper circulation was from a little north of west. The Sonora River has been so high that it could not be crossed by horses and wagons, and there are no bridges. The storm of March 13-14 was the heaviest of the season and since then no rain, except two little showers. Twice the high cirrus has set in from the southwest, but, in less than 24 hours, veered to the northwest, and during three days there was no sign of cirrus or other cloud.

A HEAVY DEPOSIT OF HOARFROST AND ITS EFFECT IN RETARDING NOCTURNAL COOLING.

By DEWEY ALSDORF SEELEY, B. S., Observer, Weather Bureau, Peoria, Ill.

On the morning of February 26, 1905, there was an unusually heavy deposit of frost and the idea was suggested of attempting to measure the actual amount of precipitation thereof, in the form of water. Accordingly a smooth, horizontal, wooden surface, about one foot above ground, was selected as a place of measurement and the task undertaken. The large galvanized portion of the rain gage was inverted upon this surface, thus marking out a circular area covered with frost, the size of the top of the rain gage. This frost was then carefully collected, by means of a large knife, and placed in the brass portion of the rain gage, the latter having previously been partially filled with water at about 60°. Several measurements of the depth of water in the gage, before and after the frost was placed therein, were very carefully made. The increase in depth resulting from the addition of the melted frost deposit was determined to be very nearly 0.018 inch.

The question was then suggested as to the heating effect of the condensation of so large an amount of vapor into frost. This was roughly determined by means of the formula

$$V = \frac{WH}{10\ W'S},$$

V being the volume of air heated 10° F., W the weight of the frost deposit per square foot, or 0.09284 pounds; H the number of heat units given out by the condensation of vapor into frost, or 1092; W' the weight of a cubic foot of saturated air at 30° F., and under a pressure 30.00 inches, or 0.081 pound; and S the specific heat of air at a constant pressure, or 0.238. From this formula V equals 525 cubic feet. In other words sufficient heat was evolved from the condensation of 0.018 inches of water, from vapor to frost, to raise the temperature of the air for about 525 feet above the surface by an average of 10° F., provided this heat was all consumed in heating the air. It can not be assumed that the heat thus evolved from the condensation of vapor into frost on a clear night is directly effective in warming the air, as it is probably very largely radiated through the atmosphere unimpeded. However, this heat does supply a large amount of the energy which is radiated from the surface of the ground and retards the cooling of the latter, thereby having a tendency to retard the rapid cooling of the atmosphere in contact therewith.

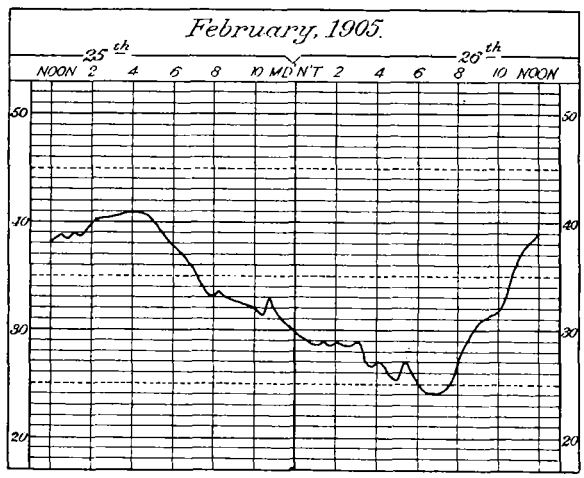

FIG. 1.—Thermograph trace from noon February 25 to noon of the 26th.

A copy of the thermograph trace from noon February 25 to noon February 26 is given in fig. 1, showing that the fall in temperature during the night was retarded. The temperature at 8 p. m., February 25, was 33°, and the dew-point at that time 32°. The temperature fell but 8° below the dew-point as determined at 8 p. m. The night was very favorable for radiation and rapid cooling, the sky being perfectly clear and the wind very light. The temperature would, therefore, undoubtedly have reached a much lower point had it not been for the heat evolved from the condensation of vapor into frost. Had the air continued to cool throughout the night at the same rate as before condensation of moisture began, the temperature would have reached 5°, whereas the minimum on the morning of the 26th was but 24°.

It is reasonably certain that a deposit of dew or frost will prevent the temperature from falling many degrees below the dew-point, as determined in the afternoon or evening preceding. Truck gardeners, cranberry growers, and others who are so greatly affected by the occurrence of frosts, and who can, in a measure, allay the destructive effects by means of flooding, "smudging," etc., might often be able to forecast with reasonable certainty whether a frost is liable to occur at a time when conditions seem favorable for it, by determining the temperature of the dew-point late in the afternoon. If the latter is near the freezing point a frost may be expected, providing other conditions favor it, but if the dew-point is found to be 8° or 10° above 32° the heat of condensation can be depended upon to prevent freezing.